NOTE

Morphological Characteristics of Flower and Seed Coat of the Endangered Species of *Thismia taiwanensis* (Burmanniaceae)

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ABSTRACT: Since insufficient materials of *Thismia taiwanensis* were collected in the past, the structural details of the annulus, stamens and other characters of this critically endangered species have not been examined. The aim of this study was to determine the characteristics of flowers and fruits, especially those of the perianth tube and stamens, using fresh material. Seed surfaces were photographed by using scanning electron microscopy. The results showed that the flowers of *T. taiwanensis* were found either without a pedicel or with an elongated pedicel that becomes carnose in the fruit stage. The latter was more common. The perianth is not covered with glands; there are six stamens, which are separate and opposite the perianth lobes, with dilated, ribbon-like connectives, pendulous from annulus. The seeds are ellipsoid to fusiform, with somewhat tapering poles, 0.2-0.4 × 0.1-0.15 mm, and with epidermal cells that are raised, with distinctly longitudinal anticlinal walls and sunken anticlinal boundaries, forming a superficial network pattern.

KEY WORDS: micromorphology, pedicel, seed coat, *Thismia taiwanensis.*

INTRODUCTION

The genus *Thismia* Griff. (Burmanniaceae) has an essentially pantropical distribution, although several species have been described from warm temperate regions. This genus typically grows amongst leaf litter on the forest floor. Owing to its small size and lack of color, that *Thismia* species locate in the field is difficult. According to Jonker's monograph of the Burmanniaceae (1938), many species are consequently only known from one or two collections. As individual *Thismia* species are only found in a limited number of localities, they are often treated as a nearly extinct or endangered species. *Thismia taiwanensis* has only been found by Yang et al. (2002) in recent years. Its habitat area is about 100 m^2. According to IUCN (2001), we suggest *T. taiwanensis* to be critically endangered.

Thismia taiwanensis was found growing amongst leaf litter in a warm temperate Fagaceae forest dominated by *Castanopsis cuspidata* (Thunb. ex Murray) Schottky, *Cyclobalanopsis morii* (Hayata) Schottky, and *Lithocarpus amygdalifolius* (Skan ex Forbes & Hemsl.) Hayata (Yang et al., 2002). The microhabitats of these small, achlorophyllous and holomycotrophic herbs are very restricted and each of this species are rare. Due to the limited availability of specimens, Yang et al. (2002) were not able to describe the structure of the annulus and stamens in detail, or to determine whether there are glands in the perianth, as reported for *Thismia* previously (Vogel, 1962; Maas et al., 1986).

T. taiwanensis is without any stem and pedicel during the flowering period, but *T. abei* and *T. tuberculata* are borne on short pedicels at anthesis (Yang et al., 2002). The peduncle is the stalk supporting a whole inflorescence, or the stalk of a solitary flower, while the pedicel is the stalk of a single flower. The difference between peduncle and pedicel in *Thismia* is that the former is covered with alternate or scattered leaves and the latter is sustending 2-3 bracts, but without leaves. We conducted detailed field studies to observe more flowers and fruits that would provide distinct information on the characteristics of this endemic species.

MATERIALS AND METHODS

To observe those uncertain characters of *T. taiwanensis*, we collected about five fresh flowers in August 2008. All the work, including dissecting and taking pictures had to be done in the field in a very short time, because the small, translucent-white plants withered quickly after exposuring to the air for even a few minutes. We did our best to get satisfactory

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dissected views with limited materials and its special plant features. The seeds were collected from two mature fruits in November 2008 and the characters of seed surface were photographed using a scanning electron microscope (SEM) (Hitachis-3000N) (Morgan, 1985).

RESULTS

Yang et al. (2002) stated that the flowers lack pedicels, but from 32 individuals observed in the field, we concluded that the flowering pedicels of *T. taiwanensis* are of two types. In addition to those without pedicels, a distinct type with elongated pedicels, which become carnose in fruit (Figs. 1 & 3), made up a higher proportion (> 80%) in the field. Figures 1 and 3 show the same individual photographed in different months, in which the pedicels can be seen clearly at the flowering stage and the pedicels are extended and thick at the fruiting stage. The flowers of both *T. abei* (Akasawa, 1950) and *T. tuberculata* (Shin, 1974) are borne on short pedicels at anthesis, *T. taiwanensis* also with pedicels in part during the flowering period. There are also differences in peduncle length: the flowers of *T. abei* are subsessile, whereas those of *T. taiwanensis* and *T. tuberculata* are borne on short peduncles (Fig. 3).

We observed that the perianth is not covered with glands. There are six separate stamens, opposite to the tepals; the connectives are dilated, ribbon-shaped, and pendulous from the throat of the perianth tube (annulus) (Fig. 2). The columns fused the ovary wall with numerous ovules attached on the surface of columns (Fig. 4).

With SEM, seed micromophology is described as follows: the seeds are ellipsoid to fusiform, with somewhat tapering poles, 0.2-0.4 x 0.1-0.15 mm, remaining attached via an elongate funiculus, with epidermal cells that are narrowly oblong, slightly spirally twisted, with distinctly raised longitudinal anticlinal wall and sunken anticlinal boundaries, forming a superficial network pattern; the surface of the outer periclinal wall is completely smooth and straight (Figs. 5 & 6). All the characteristics of the seed surface are similar to those previously described for *Thismia* genus (Maas-van de Kamer, 1998) except that the outer epidermal cells of *T. panamensis* are more spirally twisted than described here.

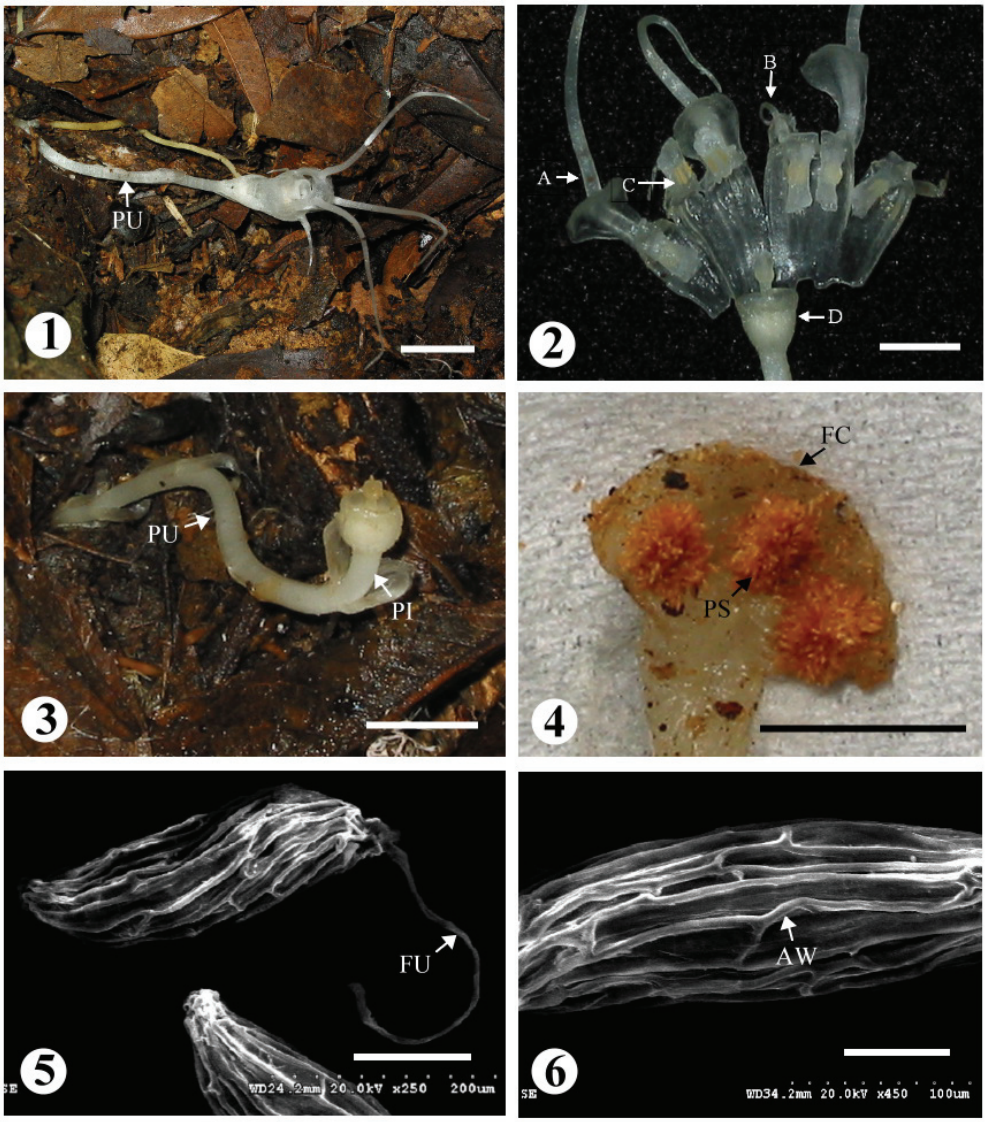
To describe all the characteristics of this endemic plant thoroughly, we combine the characters observed in this study and those of Yang et al. (2002), using bold font to highlight aspects not including Yang et al. (2002).

Small, achlorophyllous holomycotrophic herbs. Roots horizontally creeping, branched, carnose, terete. Stem ± absent at anthesis, becoming greatly elongated and carnose in fruit, ca. 1.3-4 cm long. Leaves entire, 2-6, alternate or scattered along stem**,** highly reduced, scale-like, 3-6 mm long, 0.4-3 mm wide, with single vascular trace, apex acute. Flowers solitary, flowering pedicels absent or obviously present, with 2-3 subtending bracts; bracts 5-8 mm long, 2-3 mm wide, with single vascular trace, apex acute; perianth of 6 tepals in 2 whorls, fused to form a basal perianth tube, free apically; perianth tube actinomorphic, tubular, ca. 8-15 mm long, ca. 5-7 mm wide (middle), translucent-white, circumscissile; smaller (outer) perianth lobes ca. 1.5-4.5 mm long (excluding appendage), ca. 1.5-4 mm wide, scale-like or wide-triangular, radiating outwards, with erect subulate appendage abaxially, 2.5-8 mm long, ca. 0.25-1 mm wide; larger (inner) perianth lobes ca. 5-8 mm long (excluding appendage), ca. 1.5-6 mm wide, spathulate, apically imbricate, forming loose mitre over perianth chamber, with erect subulate appendage abaxially, ca. 12-45 mm long, ca. 0.25-1.5 mm wide; ovary epigynous, tubular, ca. 1.5-5 mm long, 1-5 mm wide, unilocular, parietal placenta, with 3 columns inserted pareitally halfway up to the ovary wall; ovules numerous, attached on the surface of columns, white; style cylindric, ca. 0.5-1 mm long, ca. 0.5-1 mm diameter; stigma 3, free, ca. 0.5-1.5 mm long, ca. 0.5-1.5 mm diameter; stamens 6, opposite with tepals, pendulous from throat of perianth tube (annulus), adjacent stamens apparently free; connectives dilated and adnate to each other by their lower margins to form a tube, each connective flat-rectangle, ribbon-shaped, ca. 3-4 mm long, 1.5-3 mm wide with few hairs near truncate base, white; structure of annulus not visible; thecae 2, separate each other, extrorse, attached at the middle of the connective, ca. 1 mm long, 0.5-1 mm wide, longitudinal dehiscence, yellow; inter-staminal lobes absent. Fruiting peduncle 5-9.2 cm long, ca. 2-2.5 mm diameter (broadening towards apex), Fruiting pedicels greatly elongated and carnose, 11-65 mm long; capsule 3.3-3.7 mm long, ca. 4 mm wide, cup-shaped, carnose, translucent (-white), dehiscing apically; Seeds numerous, 0.2-0.4 mm long, 0.1-0.15 mm wide, ellipsoid, striate, covered white short hairs, yellow-brown.

DISCUSSION

The results of this study confirmed that the structure of stamens and seed surface features of *T. taiwanensis* are consistent with previous descriptions of *Thismia* (Maas et al., 1986). Fortunately, we had a good opportunity to observe the inner parts of perianth tube

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Figs. 1-6. 1: The flowering stage with visible peduncle (PU) of *Thismia taiwanensis*. Bar: 2 cm. 2: Dissected flower of *Thismia taiwanensis*. (A) inner perianth lobe, with a long erect subulate appendage ca. 12-45 mm long. (B) outer perianth lobe with a short erect subulate appendage, 2.5-8 mm long. (C) stamen, pendulous from throat of perianth tube. (D) epigynous ovary with three free stigmas. Bar: 5 mm. 3: The fruiting stage of *Thismia taiwanensis* with elongated carnose pedicel (PI), after the part of flower has abscised, the pedicel extended from the base of fruiting cup. Bar: 1cm. 4: Dissected fruit cup (FC) of *Thismia taiwanensis* with parietal seeds (PS), with columns arising from base of ovary. Bar: 5 mm. 5: SEM micrographs of seed surface and funiculus (FU) of *Thismia taiwanensis*. Bar: 200 um. 6: Epidermis of *Thismia taiwanensis* testa, narrowly oblong, with distinctly raised anticlinal walls (AW), forming a superficial network pattern. Bar: 100 um.

and the stamens (Fig. 2) clearly as those views are really difficult to get. Although we dissected and wasted some flowers, we hope all the efforts could provide critical evidence for the taxonomy of the genus *Thismia* as well.

The roots of *T. taiwanensis* creep horizontally, branch and are covered by thick leaf litters all the years, it would be interesting to know how long the species has beein growing in Taiwan during its evolutionary history. We imagine that this achlorophyllous holomycotrophic herbs might have adopted the resource allocation strategy (Tilman, 1990) to find its best adapted niche within the resource gradient. The trees, the fungi, and this plant form a symbiosis to make the survival of *T. taiwanensis* possible.

Because the habitats of this plant are located in Yunshan National Park and protected by the Government, we have had a good opportunity to

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continue our observation on the phenology of this species. The seeds of *T. taiwanensis* are very small, like dust. Since we still do not know the mechanism of seed dispersal, it would be valuable and important to study pollination, migration, colonization, as well as habitat conditions and stochastic physical factors, in the near future. Successful conservation of this plant will be influenced by the results of academic studies.

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水玉簪科臺灣水玉杯花與種皮形態特徵之研究

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摘要：臺灣水玉杯為嚴重臨危物種，因族群數量非常少，花被和雄蕊形態、種子表面顯微形態等或其他資料仍未加以描述。本研究將利用新鮮植株詳細描述其花被和雄蕊形態，並利用掃瞄式電子顯微鏡觀察種子表面顯微形態。研究結果顯示，臺灣水玉杯花莖有二型，一為無花莖，另一型為花莖延長且肉質增厚，野外以此型居多。臺灣水玉杯花被無腺點，雄蕊 6，離生，與花被裂片同數而對生，藥隔膨大長方形扁平狀，懸垂著生於花被筒咽喉部。種子呈橢圓形至紡錘形，二端有點尖，0.2-0.4 × 0.1-0.15 mm，表皮細胞具明顯凸起的縱向垂直細胞壁和垂直凹陷的區域，而構成種子表面網狀形態。

關鍵詞：顯微形態、花莖、種皮、臺灣水玉杯。

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